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On tune deafness (dysmelodia): frequency, development, genetics and musical background

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> There was an old fellow of Sheen
> Whose musical sense was not keen.
> He said: 'It is odd,
> I can never tell God
> Save the weasel
> From pop goes the queen!'
>
> (Popular rhyme)

INTRODUCTION

People who cannot sing in tune, cannot spot a 'wrong note' in a well-known melody, or who do not recognize the tune have in the past been called 'tune deaf' or, less accurately, 'tone deaf' (Kalmus, 1948; Fry, 1948; Cox, 1948). Tune deafness is undoubtedly responsible for a high proportion of those considered unmusical in earlier studies of musical ability (Koch & F. Mjøen, 1931; F. Mjøen, 1925; J. A. Mjøen, 1926). In this paper we take as our criterion the inability to detect wrong notes and describe a test for their discovery. Thus we exclude from this category those people whose inability to sing in tune is primarily motoric but who do detect wrong notes in Western popular and classical music. Those grossly defective in hearing are also excluded and the test performances of people not previously exposed to much Western style music will be discussed separately.

As a synonym for tune deafness we propose the word dysmelodia, to indicate its similarity with such defects as dyslexia (Finucci *et al.* 1976) and dysphasia. Benta (1977) has called the condition the 'sensory type of amusia'; in German it is called 'Melodientaubheit'. In this paper we define it quantitatively as a deficiency in melodic aptitude.

THE DISTORTED TUNES TEST

Our first test for tune deafness, which required the naming of tunes, proved to be inefficient.

Subsequently a test was developed that made no demands on the subject's verbal memory but determined his ability to remember the melodic line and to judge whether it is correctly rendered. For this purpose wrong notes were introduced into passages of popular melodies without changing the rhythm, and people were required to spot them, the assumption being that normal adults, brought up in Britain and exposed to these popular melodies, have incorporated their tonal pattern into their memory store so that when they hear them they can notice the distortion of the melodies. The tune deaf on the other hand would not be able to do so.

The original version of the Distorted Tunes Test consisted of a few bars from the beginning of 25 well-known English songs, played on an oscillator and recorded on a gramophone disc. Each tune was played twice, once correctly and once with some wrong notes, the 50 items

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following each other in random order. Summaries of some results obtained with this test have been published (Fry, 1948; Kalmus, 1948), but closer scrutiny of these early results showed that only 26 out of the 50 items significantly contributed to the discrimination between tune deaf and normal people, so that 24 could be omitted. The final version was a tape recording of 26 melodies with some explanatory text.

Results obtained with the old test and with the new test did not significantly differ (see Table 2) and thus could, for most purposes, be pooled. The test was administered as follows: people were seated as far from each other as space permitted and asked to enter their name, age, sex and the date on a form. They were then instructed not to crib, laugh or otherwise interact.

The recording started with the following spoken instruction:

> 'You are going to hear a number of well-known tunes played on the piano. Some are played correctly and others have wrong notes in them. Your task is to decide, after you have heard each tune, whether it was correctly or incorrectly played. Here, first of all, is an example to show you the kind of thing to expect. Listen to the first demonstration items. (At this point the first four bars of *John Brown's Body* are played without wrong notes.)
>
> That tune was correctly played, so put a tick in the box marked Demonstration 1.
>
> Now listen to the second example. (At this point the same piece of the melody is played with 9 notes wrong: the 6th, 7th, 8th and 9th are two semitones too high, the 10th, 11th, 19th and 21st one semitone too high and the 15th one semitone too low.)
>
> There were wrong notes in that item, so put a cross in the box marked Demonstration 2.
>
> You will now hear 26 items of this kind. After you have heard each tune, put a tick or a cross against the appropriate number.'

These instructions were followed by the 26 items listed and described below, each item being preceded by announcing its number. Nine of the items were correctly rendered. Their position in the sequence and titles were as follows – the number of notes recorded in brackets:

1.	Good King Wenceslaus	(13)
3.	O God our Help	(14)
6.	The Doxology	(16)
10.	Auld Lang Syne	(14)
13.	Daisy, Daisy	(16)
15.	Abide with Me	(10)
21.	Minstrel Boy	(20)
22.	Tipperary	(24)
25.	Annie Laurie	(23)

Seventeen tunes contained mistakes. Their positions in the sequence, titles, number of recorded notes (in parentheses), the position of the wrong notes in the melody and the direction and magnitude of their deviations are listed in Table 1.

In all tunes the general rise and fall of the melody was preserved, with the introduction of a few notes or a complete phrase in a wrong key.

SCORES AND REPEATABILITY

In the Distorted Tunes Test two kinds of mistakes are possible: any of the nine correctly placed tunes can be declared to contain mistakes ('false mistakes', counted as an *f*-score) and any of the seventeen wrong tunes can be declared faultless ('mistakes', counted as an *m*-score). The *m*- and *f*-scores are not highly correlated. In a sample of 989 grammar school children $r = 0{\cdot}404 \pm 0{\cdot}027$.

Table 1. *Details of Distorted Tunes*

Position in sequence	Tune	Position of wrong notes	Semitone deviation (+ = higher, − = lower)
2	Minstrel Boy (20)	4 10 11 12 13	+1 −1 −2 −1 −1
4	Grenadiers (16)	6 10 11 12	−1 −1 −1 −1
5	Annie Laurie (23)	4 5 14 16 19	+1 −1 −1 −1 +1
7	Jolly Good Fellow (24)	10 11 12 14 15 16	+1 +1 −1 −1 −2 −2
8	All Thro' the Night (12)	5 6 7 10 11	+1 +1 +2 −1 −1
9	Tipperary (24)	9 10 13 24	−1 −1 −1 −1
11	Adeste Fideles (12)	6 8 10	+1 −1 +1
12	Land of Hope & Glory (20)	13 14 15 16 19 20	−1 −1 −1 −1 +1 +1
14	Clementine (23)	10 11 12 13 14 15 18 19	+1 +2 +2 +2 +1 +2 +1 +1
16	Daisy, Daisy (15)	10 12 13 14	+1 −2 −2 −2
17	Deutschland (17)	7 17	+1 +1
18	Auld Lang Syne (14)	9 10 11 12 13	+1 −1 −1 −2 −2
19	Doxology (16)	8 9 10 11 12 13 15 16	−1 −1 −1 −1 −1 −1 −1 −1
20	First Nowell (13)	9 10 11 12 13	−1 −1 −2 −2 −2
23	O God our Help (14)	9 13 14	−1 −2 −1
24	King Wenceslas (13)	7 8 9 10 11 12 13	−1 −1 −1 −1 −1 −1 −1
26	Old Folks at Home (13)	7 8 9 10 11 12 13	+1 −1 +1 +2 +1 +2 +1

Table 2. *Repetition of the Distorted Tunes Test by 55 British adults*

(Distribution of scores: m_1 = first score, m_2 = later score, numbers in parentheses correspond to a long interval before retesting.)

	m_1									
m_2	0	1	2	3	4	5	6	7	8	9+
9+	—	—	—	—	—	1	—	—	2	1
8	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	1	(1)	1	(1)	—
6	—	—	—	—	—	1	—	—	—	—
5	—	—	1	—	1	—	—	1 (1)	—	—
4	—	—	—	—	—	—	1	(1)	—	—
3	—	—	—	—	1	1 (1)	—	—	(1)	—
2	—	—	2	1	—	—	—	—	—	—
1	1	(3)	1	—	—	—	—	—	—	—
0	15 (10)	1 (1)	(1)	—	—	—	—	—	—	—

The items in which the tune was played wrong and marked right by the subject (the *m*-mistakes) are obviously the most important. Nevertheless attempts were made to combine both scores into a discriminating equation. For the original 50 items test $D = 3m - f$ was used as a discriminant function and correlations with Seashore's Pitch and Tonal Memory Tests (Seashore, Lewis & Saetweit, 1946) as well as with a specially devised Number Memory Test were calculated on this basis (see Table 6). However, the simple m-score on its own seemed good enough. The nine faultless tunes simply serve as controls.

Occasionally extraordinary scores were recorded, requiring further investigation. One person, for instance, declared all 26 tunes faultless, while another considered that all contained wrong notes. These responses and similar ones were either the result of misunderstanding the instructions, in which case repeating the test produced an interpretable score, or they signified a high degree of tune deafness.

The reliability of the Distorted Tunes Test as well as the comparability of scores obtained with

Table 3. *m-scores of* 130 *adults considered musical and of* 20 *adults considered tune deaf*

No. of distorted tunes missed = m	0	1	2	3	4	5	6	7	8	9	15
BBC Listening Panel considered musical											
♂	62	8	1	—	—	—	—	—	—	—	—
♀	52	6	1	—	—	—	—	—	—	—	—
♂+♀	114	14	2	—	—	—	—	—	—	—	—
♂+♀*	113·2	14·3	1·5	0·05	—	—	—	—	—	—	—
Considered tune deaf											
♂	—	1	3	—	1	2	2	1	2	—	—
♀	1	—	—	—	—	1	1	2	2	—	1
♂+♀	1	1	3	—	1	3	3	3	4	—	1
♂+♀†	17·5	2·2	0·3	—	—	—	—	—	—	—	—

* Poisson distribution.

† Fitted to a Poisson distribution derived from the BBC Panel.

the original 50 items test and the new 26 tunes version was established by retesting groups of adults. One group was originally tested with the 50 items and retested with 26 items after periods between 24 and 30 years (long term repeats), while the other group was both times tested with the 26 items after intervals of a few weeks or months (short term repeats) (Table 2). The correlations between the first and second tests are high, being $r = 0{\cdot}889 \pm 0{\cdot}059$ for the long term repeats and $r = 0{\cdot}816 \pm 0{\cdot}059$ for the short term repeats.

The critical value of m

One of the difficulties in the classification and genetics of behavioural deficiencies is the separation, among the slightly affected (for example, the 'high-grade mentally defectives'), of those belonging to the tail of a distribution which includes the normal whose deficiency may be caused by many factors, from those who are damaged by a single factor which can be a 'major' gene. Sometimes a bimodal distribution of some relevant measurement may provide a clue but frequently the presence of a special factor only results in a 'long tail'. This applies to the m-scores for tune deafness, when applied to our unselected population. A way of diagnosing tune deafness had nevertheless to be found. It derived from a comparison of the m-scores of British adults, selected for their musicality (a panel of the British Broadcasting Corporation), with the scores of other British adults who considered themselves to be tune deaf, or were so considered by others (Table 3).

The scores of the musical people show a close fit to a Poisson distribution, with none higher than $m = 2$ while the much more frequent mistakes of the presumed tune deaf follow a quite different distribution, indicating that some presumed tune deaf were probably normal, while most of the others scored far beyond $m = 2$. Comparing the two distributions, it is reasonable to consider any adult British person who scores 3 or more as tune deaf and anybody scoring 2 or less as normal. Children and adolescents (under 16), as well as people not used to English tunes, produce higher m-scores and different criteria must be applied for the diagnosis of tune deafness.

Table 4. *m-scores of* 604 *adults not selected for musical ability or tune deafness*

m	0	1	2	3	4	5	6	7	8	9	14	T
Males (%)	216	36	9	2	4	1	2	—	—	1	—	271
	79·7	13·3	3·3	0·7	1·4	0·4	0·7	—	—	0·4	—	99·9
Females (%)	258	47	13	7	—	2	—	—	3	—	3	333
	77·5	14·1	3·9	2·1	—	0·6	—	—	0·9	—	0·9	100·0
Females + males (%)	474	83	22	9	4	3	2	—	3	1	3	604
	78·5	13·7	3·6	1·5	0·7	0·5	0·3	—	0·5	0·2	0·5	100·0

THE FREQUENCY OF TUNE DEAFNESS IN AN ADULT BRITISH POPULATION

Table 4 summarizes the m-scores of 604 adults from 4 samples: academic and technical staff of Rothamsted Experimental Station, Harpenden (46), staff and students of University College London (148), people incidentally tested when visiting the Galton Laboratory (129), and pupils over 16 years of age (281) from the schools recorded in Table 5.

The m-scores of men and women do not greatly differ. Overall 3·6 % of the males and 4·5 % of the females scored 3 or more and can be classified as tune deaf. One may reasonably consider 4·2 % as an estimate for both sexes of the frequency of tune deafness among English adults.

THE DEVELOPMENT OF MELODIC APTITUDE

Speed and final perfection of the melodic aptitude vary enormously between individuals. Tune deafness can be regarded as an extreme form of arrested development of this faculty. Anecdotal material (Révész, 1925) suggests that some individuals (e.g. Saint-Saëns, Mozart) had good musical discrimination at 3 years of age. But in our investigations the attention of small children wandered. The youngest child to complete the test correctly was a girl aged $8\frac{4}{12}$. The gradual improvement of the m-scores between the ages of 5–18 years is shown in a 'horizontal' study of 1541 schoolchildren which is summarized in Table 5. In Fig. 1 the percentages of the same children, scoring $m > 2$, are shown as well as the performance of some children from orthodox Jewish schools in North London and Dutch children tested in Holland. The performances of 13 British children under age 9 are disregarded. From this age on the percentage of children failing according to the adult criterion for tune deafness ($m \geqslant 3$) gradually decreases from about 40 % to the adult value of about 4 %. The proportion of children making at least one m-mistake stays over 50 % until age 12, when it starts to decrease in parallel with the percentage of tune deaf. There is no significant difference in performance between boys and girls, except perhaps between 9 and 12 years, when the girls are somewhat better. A child under 15, scoring $m \geqslant 3$, cannot without further consideration be assumed to be tune deaf. On the other hand scoring $m < 3$, signifies normality. The inferior performance of the orthodox Jewish and Dutch children can be attributed to their lack of familiarity with the test material (see Fig. 1).

CORRELATIONS WITH OTHER TESTS

The results of the original 50 item test were compared with Seashore's (1946) Tests for Tonal Memory and for Pitch Discrimination as well as with a specially devised Test for Number

Table 5. *m-scores of* 1541 *English children* (*girls in parentheses*)

m-score	Age										Total
	5, 6	7, 8	9, 10	11	12	13	14	15	16	17, 18	
13+					(3)	1					1 (3)
12	1		(1)		1	1 (1)			(1)		3 (3)
11					2 (1)		(1)			(1)	2 (3)
10			(1)	(1)	(1)						— (3)
9				1	2	3 (2)					6 (2)
8				2 (2)	1 (4)	(4)	1 (1)	(1)			4 (12)
7			(1)	2 (2)	2 (1)	1 (2)	1 (1)	(1)			6 (8)
6	1		(1)	2 (3)	5 (3)	5 (3)	(5)			1	14 (15)
5			(2)	(1)	3 (2)	2 (1)	2 (2)	(1)			7 (9)
4	1	(1)	(1)	4 (2)	9 (2)	4 (1)	3 (4)	2 (1)			23 (12)
3	(1)	1	2 (2)	8 (7)	4 (8)	8 (7)	4 (5)	3 (1)	1 (2)	(2)	31 (35)
2	1	(2)	1 (2)	9 (14)	14 (18)	13 (19)	7 (1)	3 (2)	3 (5)	(1)	51 (64)
1		(4)	(3)	8 (23)	17 (35)	28 (18)	20 (24)	8 (18)	10 (10)	9 (11)	99 (146)
0			(12)	29 (44)	24 (78)	111 (105)	98 (115)	57 (84)	62 (68)	40 (56)	416 (563)
Total	4 (1)	1 (7)	3 (26)	60 (99)	84 (157)	177 (163)	136 (159)	73 (109)	76 (86)	49 (71)	663 (878)

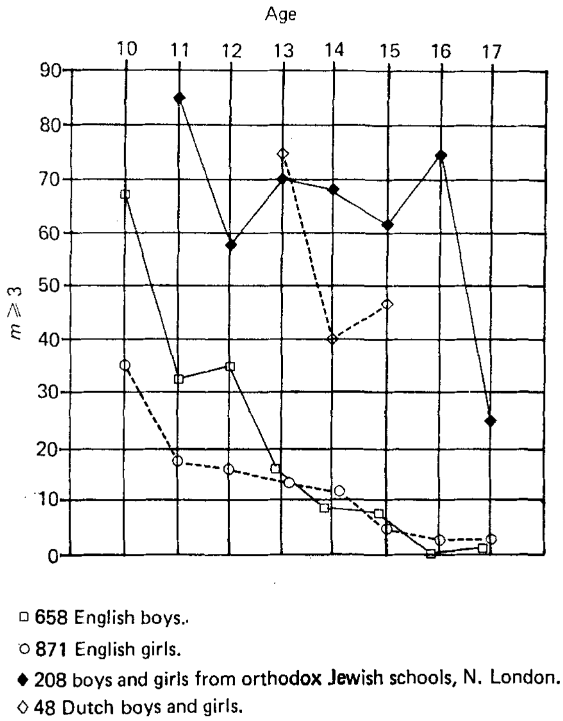


Fig. 1. Percentage of children scoring above the critical value ($m > 2$) of the Distorted Tunes Test according to age, school and country.

Table 6. *Correlation of Distorted Tunes, tonal memory, pitch discrimination and number memory tests*

	Distorted tunes	Tonal memory	Pitch discrimination	Number memory
Distorted tunes	—	0·546	0·415	0·154
Tonal memory	0·546	—	0·479	0·269
Pitch discrimination	0·415	0·479	—	0·109
Number memory	0·154	0·269	0·109	—

Memory. The pitch discrimination test consists of pairs of pure tone signals of 0·5 seconds' duration, differing by graded amounts of frequency and spaced by 0·5 s. A high correlation of the scores from this test with the scores of the Distorted Tunes Test would suggest tune deafness is a consequence of defective pitch discrimination, presumably residing in the ear. Seashore's tonal memory test measures the ability of an individual to remember for a short time sequences of tones not previously heard and to spot alterations in a repeated rendering. Though the Distorted Tunes Test measures long-term memory, a high correlation between it and the Seashore test would support the hypothesis, that the material defect underlying tune deafness is a deficiency in 'Gestalt perception' probably localized in the cortex. The idea of the Number Memory Test was to get a measure of short-term memory for some material presented to the ear which did not involve any kind of musical ability. Design of the test was similar to the Tonal Memory Test: sequences of numbers increasing in length were read aloud at a standard rate of 60/min, each repeated after a pause of 2 s with one number altered. The number substituted in the second version and which did not occur otherwise in either version, was scored.

The correlations between the 4 tests, based on 989 grammar-school children were as shown in Table 6.

Not unexpectedly tune deafness and tonal memory are more closely related than either is to pitch discrimination. All three acoustic tests are slightly related to number memory, particularly tonal memory. However, none of the additional tests contributes much to the diagnosis of tune deafness and they were not later applied.

MENTAL DEFECT

It was not possible to persuade a sufficient number of adult subjects to undergo intelligence tests and school administrations were not prepared to give us their data. Instead, two special groups of adults were compared with the general population: 26 members of the tea club of a mental institution (IQ = 50–60) and 60 academic and scientific staff of University College London and Rothamsted Experimental Station. The *m*-scores of the three groups were as shown in Table 7.

It appears that both the high grade defectives and the presumably highly intelligent academics contained significantly higher proportions of individuals scoring $m = 3$ or more; i.e. 42·0% and 11·5% respectively as against 4·2% for the general population. ($P < 0{\cdot}001$, $P \simeq 0{\cdot}02$ respectively). The high frequency of tune deafness among the small group of academics is probably caused by sampling bias, whereas in the defectives it must be their general debility that produces their high scores even though many of them were quite successful.

CULTURAL INFLUENCES

Like most performance tests, the Distorted Tunes Test is not independent of the cultural background. The decisive factor is the familiarity with the British melodies, or more precisely with the tonality of European traditional music. Table 8 summarizes the *m*-scores of a few adult samples, collected, as occasion arose, in the respective countries.

As expected, the British adults performed better than any of the foreign groups; nevertheless many people in foreign countries passed the criterion for normality established for the British and some made no mistakes even when they knew hardly any of the melodies. These adults must have developed a set of rules for judging the acceptability of a melody. From the few tests of Asian students it would appear that people not previously exposed to much of the diatonic music of the West have not acquired this particular competence. On the other hand, tune deafness in people brought up in the West points to their lack of a genetical component that, in analogy to Chomsky (1963, 1972), we might call the deep structure of melodic aptitude, and which might be the innate basis of the tonal aspect of all musical traditions. The present paper deals only with the isolation of this genetical component from cultural factors within the European music sphere.

CROSS MUSICAL TESTS

The relative importance for success in Distorted Tunes Tests of familiarity with the individual test items as opposed to the possession of the generalized tonal rules of Western music has been investigated by testing people from two nationalities – British and German – with tests based

Table 7. *m-scores of three population samples*

	N	0	1	2	3	4	5	6	7	8	9	10	11+	$\leqslant 2$	$\geqslant 3$	T.D. (%)
General population	604	474	83	22	9	4	3	2	—	3	1	—	3	579	25	4·1
High-grade defectives (IQ = 50–60)	26	5	9	1	1	—	2	2	1	2	1	1	1	15	11	42·3
University and Research Staff	61	42	9	3	1	—	3	1	1	1	—	—	—	54	7	11·4

Table 8. *m-scores of samples of different nationalities*

	N	0	1	2	3	4	5	6	7	8	9	10	11+	$m \leqslant 2$	$m \geqslant 3$	$m \geqslant 3$ (%)
English	604	474	83	22	9	4	3	2	—	3	1	—	3	579	25	4·1
German	93	42	16	12	3	4	5	4	3	—	2	1	—	70	23	24·7
Dutch	23	7	4	2	3	3	1	—	1	—	—	1	1	13	10	43·5
Italian	35	3	8	5	3	7	4	3	—	2	—	—	—	16	19	54·3
Other Europeans	24	9	3	1	2	4	4	—	1	—	—	—	—	13	11	45·8
Brazilian	94	12	20	14	15	11	7	3	5	3	1	2	1	46	48	51·1
Indian and Pakistani	17	—	2	1	—	2	—	—	2	1	1	3	5	3	14	82·4

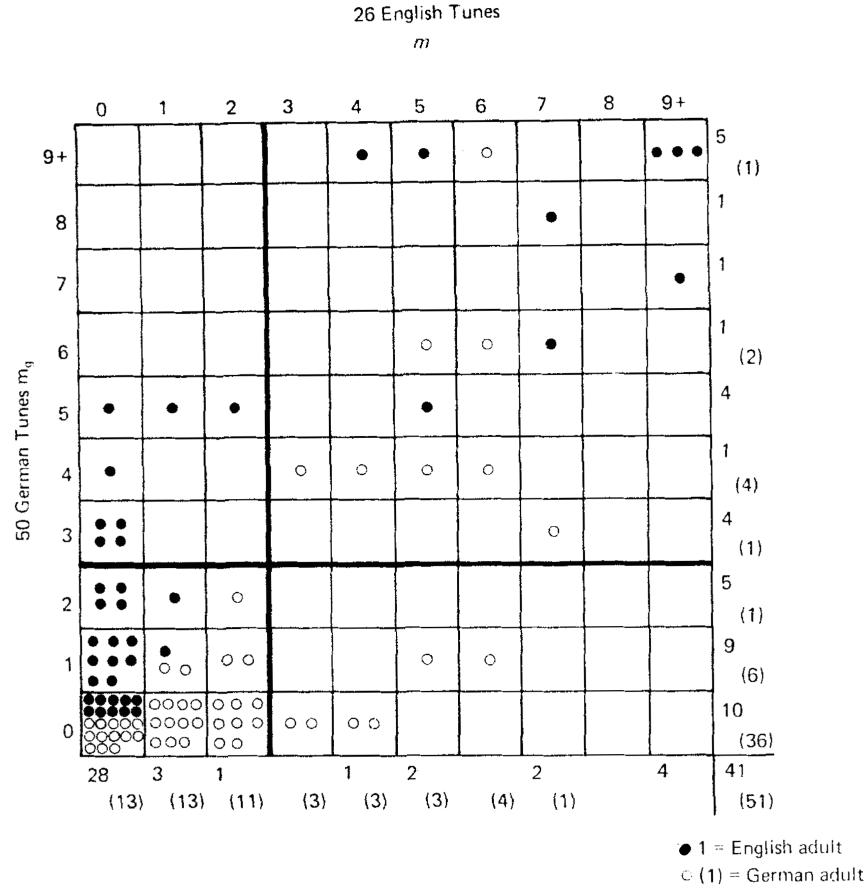


Fig. 2. Scores for tests composed of 26 British (m) and 50 German (m_g) distorted melodies on 41 British and 51 German adults.

Table 9. *Mean British and German m-scores*

		Sample	
		British	German
Tunes	British (m)	1·93	2·00
	German (m_g)	2·95	0·94

on melodies from their own and the other's tradition. For this purpose a Distorted Tunes Test was constructed, similar to the original British one but consisting of the beginning of 25 German popular tunes, each once rendered correctly and once with mistakes, in random order. Fifty-one German adults and forty-one English adults were then tested with both the German and the English tape. Fig. 2 shows the results. There is a high correlation between the two test scores, $r = 0{\cdot}807 \pm 0{\cdot}055$ for the British and $r = 0{\cdot}633 \pm 0{\cdot}086$ for the German adults. The average numbers of m-mistakes per individual were as shown in Table 9. As expected, each nationality did better when tested against its own tunes. Nevertheless, out of a possible 1025 m-mistakes in the German test, only 121 (11·96 %) were missed by the British and out of 867 m-mistakes in the British test only 102 (11·8 %) were missed by the Germans. Clearly judgements were mostly based on knowledge of the structure of Western melodies.

GENETICS

We attempt genetical analysis of British families and individuals. But even among those the classification, though usable for adults, is imperfect for children. It is impossible to correct the tune deafness scores of children simply by age, as the speed of development of melodic aptitude varies enormously (Table 5). Thus only tentative conclusions can be drawn. However, if in a family an older child misses a few 'wrong notes' while a younger sibling is perfect, we may tentatively conclude that the older carries a gene which makes it tune deaf.

Pedigrees

Inspection of Fig. 3 shows that tune deafness occurs in and is transmitted by both sexes. Except for families 6, 7 and 8, it shows in all parent generations, where a child is affected. In the families with one affected parent the trait segregates roughly in a 1:1 proportion, the preponderance of the tune deaf probably being due to sampling bias. As the number of people who could not be tested is considerable, a definite statement concerning the genetics of tune deafness is impossible. At present, as is common in the genetical analysis of human behavioural traits (Childs, 1972), a multiplicity of alternative explanations is possible. The simplest description would be that tune deafness, as defined in this paper, is largely an autosomal dominant trait, highly variable in severity and not quite completely penetrant. Not in agreement with this interpretation is the total of 4 tune deaf and 5 normal children in the four families 1, 2, 12 and 18, where both parents are affected and where, from the assumption of autosomal dominance, a 3:1 ratio would be expected. However, these numbers are very small.

Siblings

From British people over 16 years of age two kinds of propositi were selected for further investigation of their siblings if these were also over 16 years old: (1) twins, irrespective of their melodic aptitude, and (2) those who scored $m > 3$.

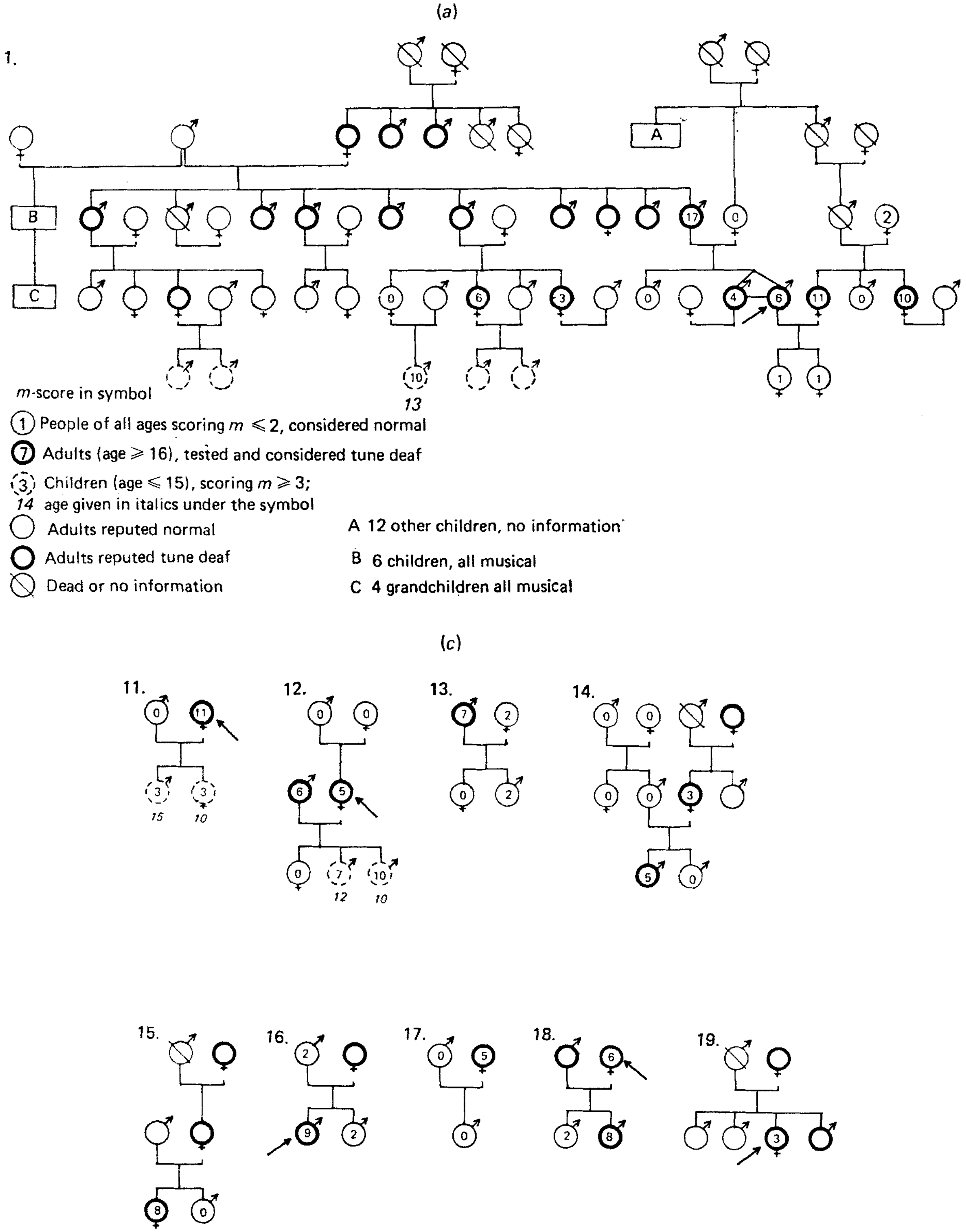
Among 12 such twin pairs 10 were concordantly normal and 2 concordantly tune deaf, one of monozygotic males ($m = 7$ and 5) and one of dizygotic males ($m = 9$ and 6).

Of 50 tune deaf over 16 years of age who had non-twin siblings in school – also over 16 years – 24 had a normal sib and 26 formed 13 tune deaf pairs. Considering that the sampling method employed necessarily misses normal pairs which are descended from parents, one of whom is tune deaf, such a result would be expected in an autosomal dominant trait.

Assortative mating

The 67 British couples we tested in our material showed a strong tendency for the tune deaf to marry others who were also tune deaf. The combinations were as in Table 10. Since the percentage of tune deaf individuals among these couples far exceeds the percentage in the population at large, the tested couples can hardly be random samples of couples. There is nevertheless within the sample itself strong evidence of assortative mating. Had the 11 affected and 56 unaffected males randomly married the 16 affected and 51 unaffected females, the probability of obtaining 7 or more tune deaf would be a little less than 0·0025.

A sample of 19 foreign couples of various nationalities showed that in the majority both spouses either scored $m \geqslant 3$ (5 couples) or both $m \leqslant 2$ (6 couples). This, however, must be partly attributed to the common national background of the marriage partners.


(a)
1.
A
B
C
m-score in symbol
13
① People of all ages scoring $m \leqslant 2$, considered normal
⑦ Adults (age ≥ 16), tested and considered tune deaf
③ Children (age ≤ 15), scoring $m \geqslant 3$;
14 age given in italics under the symbol
○ Adults reputed normal
○ Adults reputed tune deaf
⊘ Dead or no information
A 12 other children, no information
B 6 children, all musical
C 4 grandchildren all musical
(c)
11.
15
10
12.
12
10
13.
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16.
17.
18.
19.

Fig. 3. Pedigrees of 19 families containing tune-deaf individuals.

(b)

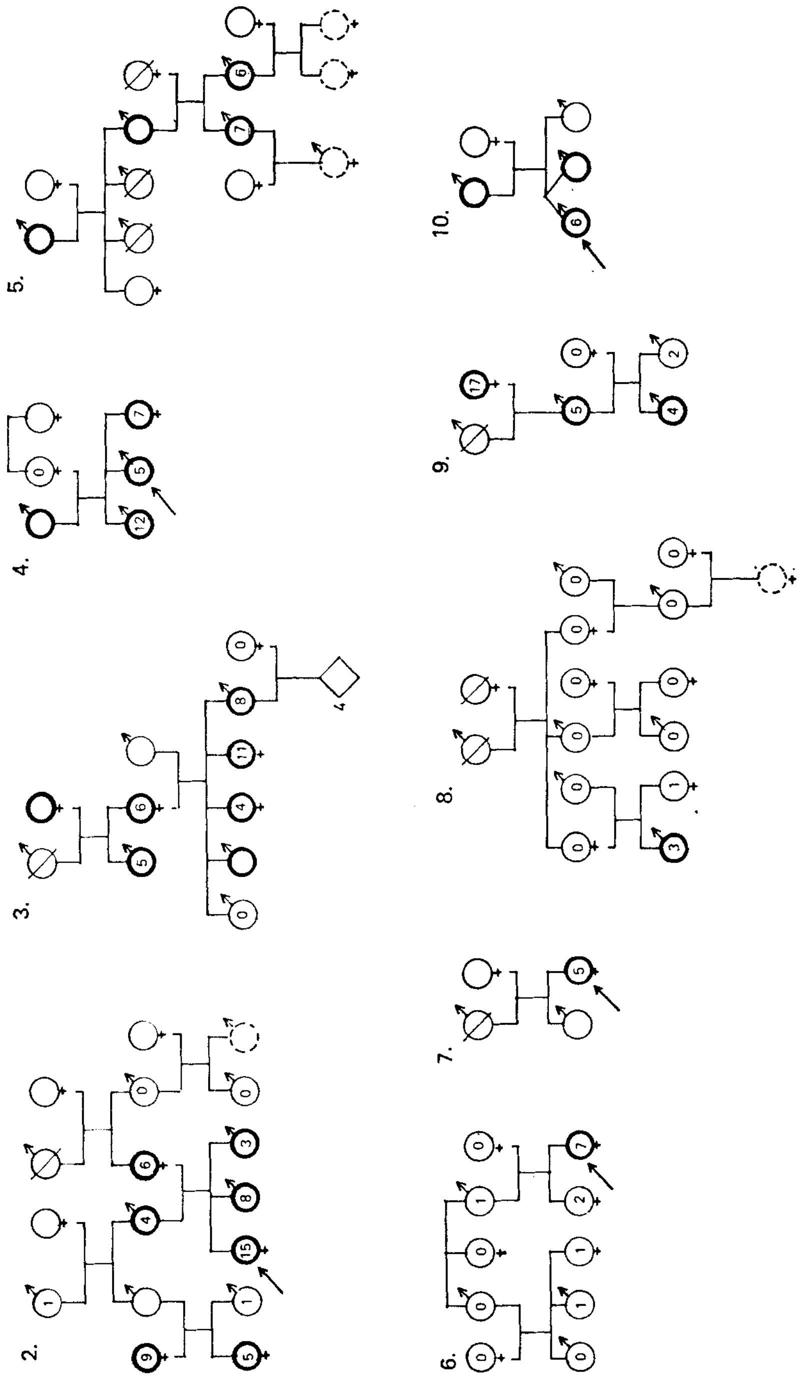

Table 10. *m-scores of husband and wife*

		Husband	
		$m \leqslant 2$	$m \geqslant 3$
Wife	$m \leqslant 2$	47	9
	$m \geqslant 3$	4	7

SUMMARY

With the aid of the Distorted Tunes Test a group of British adults could be established whose melodic aptitude was below a certain level and whom we called tune deaf. They are only a fraction of those popularly called tone deaf. The Distorted Tunes Test is only slightly correlated with pitch discrimination, short term tonal memory or number memory. In children ability to pass the Distorted Tunes Test develops at greatly varying speeds and to a varying degree, reaching stability in adolescence. Tune deafness has a familial distribution and segregates in a way suggesting an autosomal dominant trait with imperfect penetrance. Some degree of positive assortative mating has been established.

Some people, unfamiliar with the British melodies which form the basis of the test, pass it. This indicates the existence of a partly innate and partly acquired competence to judge what is acceptable and what is not, within the tradition of Western popular or classical music. This seems to indicate the existence of some deep structure of tonality, comparable with Chomsky's deep language structure. Asians who have not been much exposed to this kind of music find the task very difficult.

Details of the Distorted Tunes Tests can be obtained from the Archives of the Galton Laboratory, University College London, where tape recordings of the tests are kept.

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